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Solar drying of tomato in the arid area of TOUAT (Adrar, Algeria)

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Abstract

Our work presents experimental results of drying, which are made in the south of Algeria Adrar exactly. View that the distance between Adrar and other cities is more than 700 km and that this city is one of the cities that have a large tomato production and marketing of this crop is very difficult, we thought of method storage of this product for the market throughout the year. In our experiments we used varieties of tomatoes that are produced in this city. These varieties have water content ranging from 68 to 75% above varies depending on the degree of ripeness. The experiments were performed with an indirect solar dryer with forced convection. The experiments show the influence of the variety of tomato on drying curves, the temperature of the drying air and the size of the cut slices.

keywords: Solar drying, solar, indirect dryer, drying kinetics, Tomato, Performance dryer.

1. Introduction

The tomato (lycopersicum esculentum) is a herbaceous plant which is part of the family of solanaceous [1] like potato, the pepper, the aubergine, the tobacco. It is cultivated under almost all the latitudes, on a surface of approximately 3 million hectares, which represents nearly one the third of the world surfaces devoted to vegetables. The form generally spherical, is more or less flattened, more or less corded, but there are some in the shape of heart or of pear, the color, initially greenish, generally transfers with the red with maturity, but there are the white ones, yellows, the black ones, pinks, the blue ones, violets, oranges and the two-tone ones. The tomato is a plant of hot moderate climate as the zone of TOUATE with Adrar whose weight varies from 100 to 300 grams. Considering the condition climatic the period of harvest is ego of May to ego of June [2, 6], there is each year an excess of harvest and not of stock rooms or factory of conservation close to Adrar, these conditions obliges us to think of an effective storage solution and what has us to direct worm solar drying.

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2. MATERIAL AND METHODS

2.1. Varieties of tomatoes in Adrar

The tomatoes which one finds in Adrar can be gathered in two types: local varieties and improved varieties. The local varieties used in us experiments are:

a. Abraham Lincoln has: Variety of tomato of mid-season to marbled red fruits [5].

b. Pink Zatopec: Soft Mexican tomato in the sweet pepper shape [5]

The improved variety used in us experiments is:

c. Anna Russian has: early tomato originating in Russia, red fruits in the shape of sphere or heart.

2.2. Preparation of tomato.

The tomatoes are washed with clean water, drained then weighed and cut out using a knife slicing out of stainless steel to avoid blackening on the surface of fabrics. One eliminates all wounds, or zones soft and brown. The fruits will be cut on length or the broad one in slices of four 4 to six 6 mm thickness [6].

2.3. Equipment of drying Solar

Solar drying was tested with the site of Adrar (south-western Algerian). The experiments were carried out on a solar drier with convection forced, designed by a group of researchers, comprising 10 trays of a capacity of 2.5 kg tomato each one. Each tray has a dimension of 1 x 0.5 m, the maximum flow of the ventilator is of 1500 m^3/h. The trays are deposited on a support of 1 m height.

Our drier is presented in the figure (fig.1), it consists of:

1 - Ventilator ,2 - Trays ,3 - Collector ,4 - Solar panel with air ,5 - Cupboard of drying ,6-Cupboard of ordering of the ventilo ,7 - auxiliary Electrical power box

Fig.1. Drier used

3. Study of drying

With an aim of studying the influence of the variety (water content), the thickness of the slices with dried and temperature on the kinetics of drying, it was carried out a solar drying indirect, the tomato

strips laid out on the trays are not directly exposed to the sun. The kinetics was given while following the variation of mass of the slices and the water content of the product according to the duration of drying.

4. Results and discussions

Solar drying was carried out on three independent trays, for each studied variety. The curves show that drying during the night edge not but there is a deceleration. Drying takes again the morning with a speed (slope of the curve masses – time) higher than in the end of the day. For the three varieties solar drying is rigorously identical during the first two days of drying, the difference appears at the end of the drying where the variety Irwin dries slightly more quickly. The variety with low water content (Pink Zatopec) does not dry more quickly than the others. The time of average solar drying is from 2 to 3 days. However at the end of 24:00 of drying, 75% of water are eliminated for all the varieties. A first improvement of solar drying would be to bring a contribution of heat at the end of the drying. Figure 2 gives the evolution of the water content of the same variety of tomatos (Anna Russian) according to time for three thicknesses of the slices: 4 mm, 6 mm and 8 mm. The curve of the fig.2 then shows us that the thickness influences the speed of drying, the increase the time of drying is a direct resultant of the increase thickness of the slices to be dried. On the basis of drying with 0.5% of water content bases dries, one notes 65 mn for the slice of 4 mm, 200mn for that of 6 mm and almost 350 mn for that of 8 mm what shows the importance of cutting (thickness of the slices with dried).
The loss of mass is function of the mode of drying and the temperature applied. These curves take the same forms as those described by Desmorieux [3], Bimbenet and al. [4]. The variation of the duration of drying according to the temperature is explained by the fact why the rise in temperature involves an increase in the intensity of the transfer of heat [4].

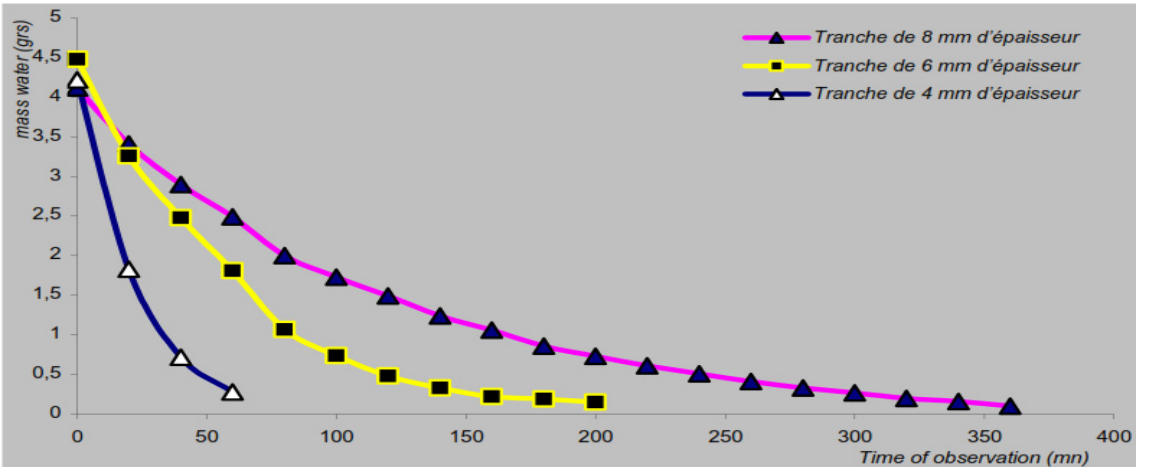

fig.2: Evolution of the water content in base dries

5. Conclusion

The experiments of drying showed that the variety of tomato influences the curves of solar drying, that because the varieties can present very different water contents initial like our case. It was also concluded that for temperatures of drying lower by 40 °C, the curves of drying of the various varieties, for the same conditions, has almost the same pace (almost confused the ones on the others), but since the

temperature is higher than 40°C, the curves differ according to the varieties. The most influential factor is the thickness (size) tomato slices.

At the conclusion of our study, we can conclude what follows:

- The study of the solar kinetics of drying of tomato shows the single presence of the phase of deceleration and the absence of the phase of temperature setting and the phase with constant pace, as it is the case of the majority of the agricultural products.

This is due to the structure of these products. The water content and the speed of drying were affected by several parameters (the temperature of the air, the speed of air, the thickness of the product and the pretreatment).

- The increase in the temperature of the air of drying and the reduction thickness of the slices make decrease the time of drying and make increase the speed of drying. - The effect the air velocity is less in comparison with the effect of the temperature; this is due downwards of temperature of the product (cooling) caused by the increase air velocity draining.

To improve the solar operation of drying, we propose:

- A system of regulation of moisture.
- A rearrangement of the auxiliary electric source.
- The products used must arrive of the same source, because one must have same sampling for the experimentation.

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